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# Diverse Sensing for Synergistic Protection in Urban Threat Environments

## Demonstration Results



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*29 April, 2010*

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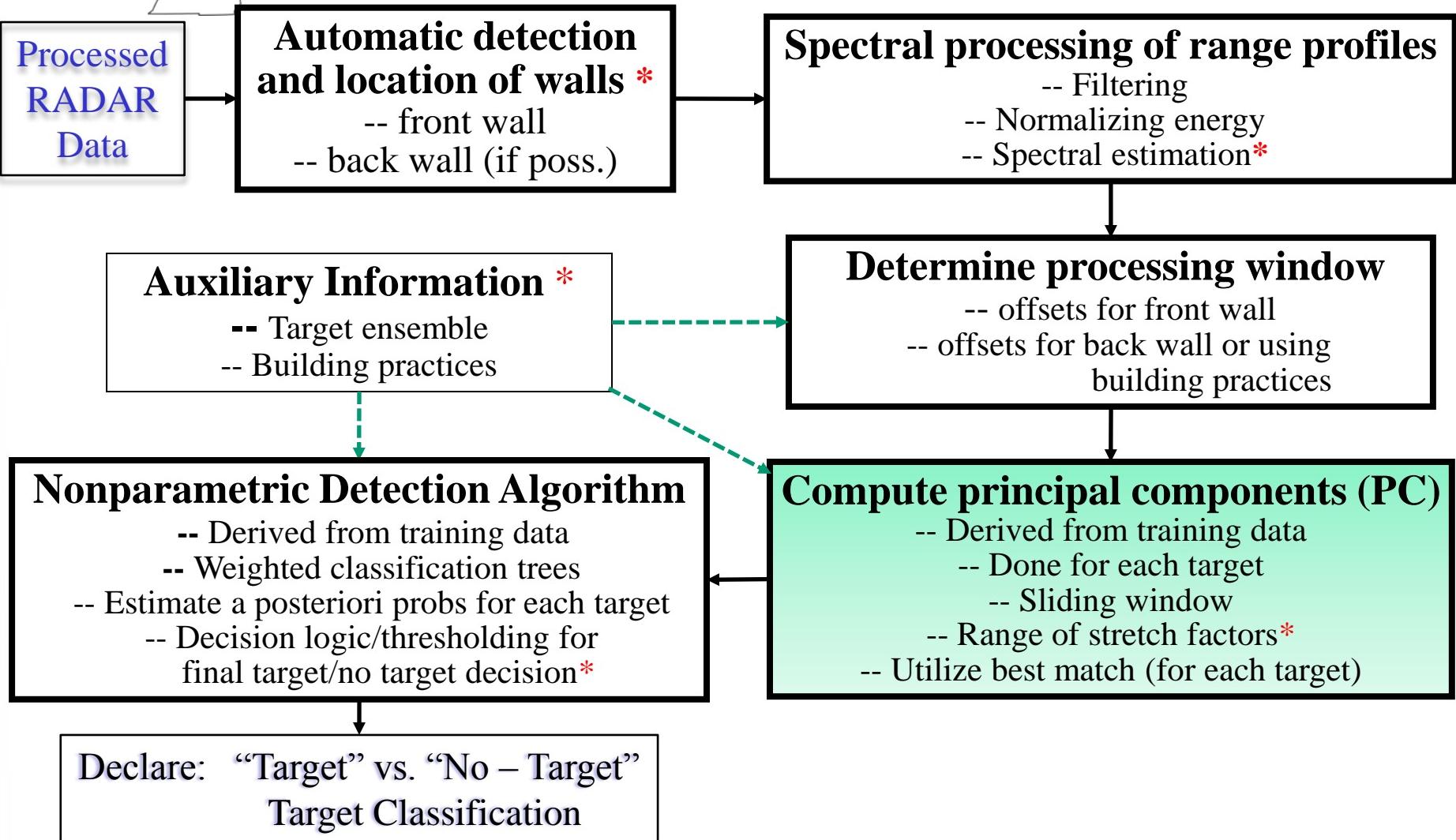


# Objective

- Show reasonable time, automated algorithm performance of pre-shot cueing algorithm on live, blind test collected data



# Automated Detection Algorithm Flow Diagram



\* Corresponds to a significantly new component for this program

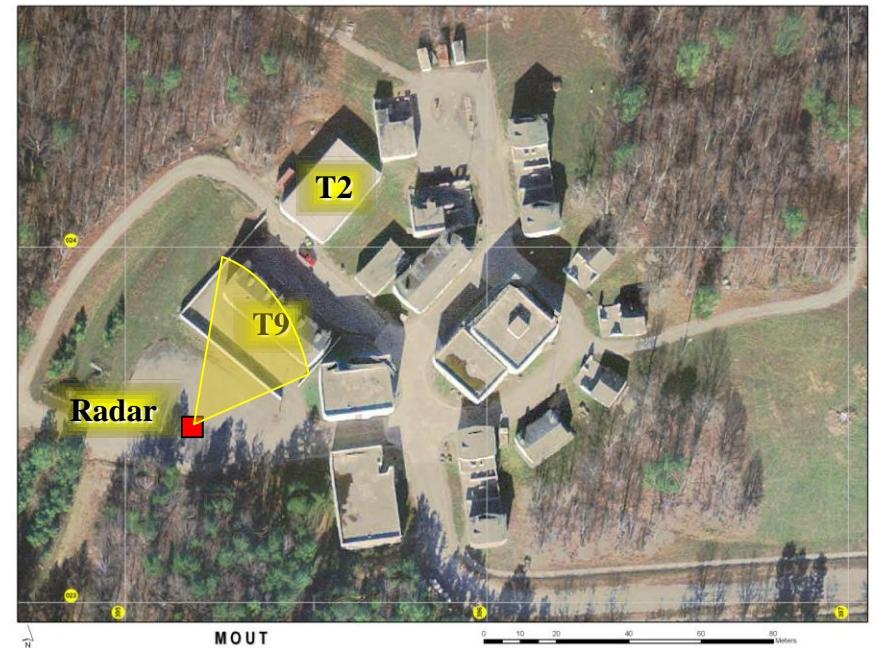
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From Science to Solutions



# Demonstration Location

- Ft. Pickett MOUT site
- Deployment at 'Warehouse building' (T9)
- Processing/display at 'Schoolhouse' building (T2)



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# MTRIs Rotating Antenna Stage

- Antenna head mounted on adapter for servo-controlled rotation stage
  - provides estimates of antenna azimuth

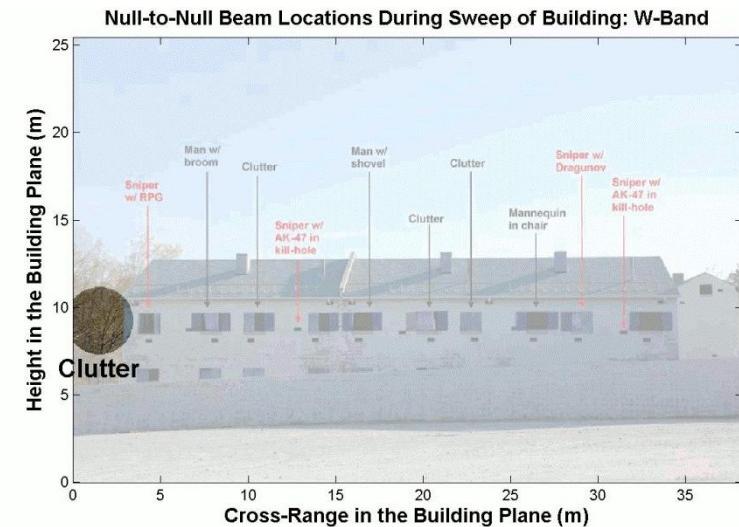


- Collection used continuous rotation rate of 0.2 °/s with frequency sweep rate of 2 Hz
  - **emulates a rotating antenna at 200 °/s with 2 kHz frequency sweep rate**



# Demonstration Structure

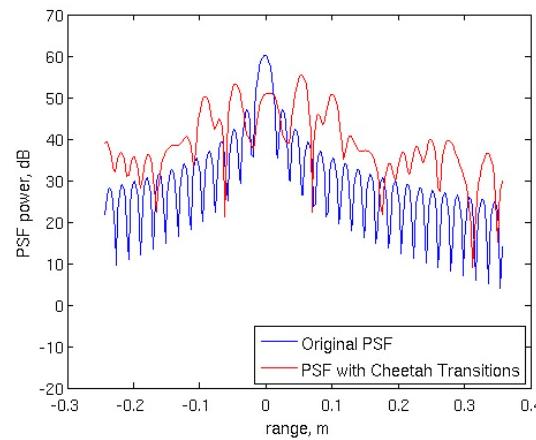
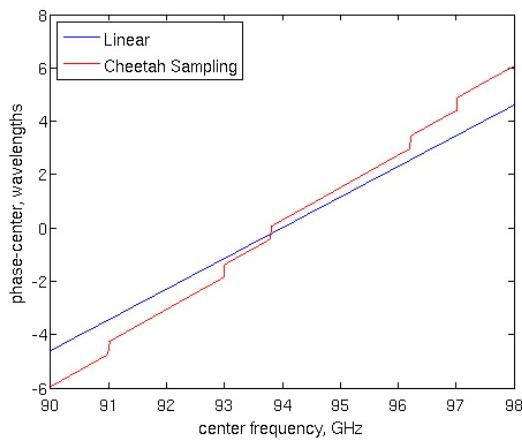
- Azimuth scan on single building
  - Set up time too long to move, re-align instrumentation system
- Confusers/targets need to remain ‘still’ during illumination
  - Long sweep time of instrumentation radar (100 msec) and short wavelength (3mm, W band) make data susceptible to scintillation and smear
  - Field operational Radars have much faster sweep times (<100usec) which will effectively ‘freeze’ signatures
- Targets will be > 1 foot behind plane of walls
  - EO system will see threat if exposed at opening
- Radar and target will have direct line of site and have weapon pointed at Radar
  - Threat is defined as weapon pointed at vicinity of Radar





# Measures to Mitigate Scene Motion

- Long chirp time (100ms) and non-uniform filter transition time coupled with small wavelength (W band) creates phase anomalies in moving targets



- Used monopods in Demo to mitigate PRF spoiling due to range-relative target motion

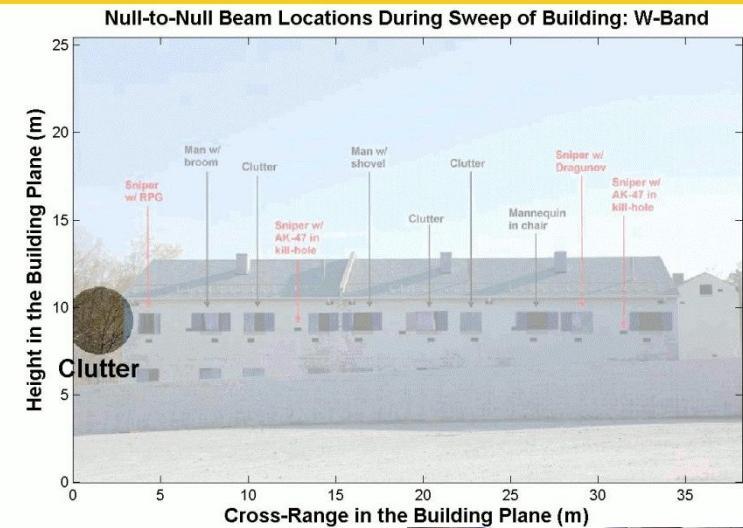


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# Demonstration Structure

- Scan set #1
  - False alarm testing
    - Scan #1: building with confuser targets
      - Empty rooms, people, people with implements
        - » Positioning of people determined on site with government
      - Scan #2: completely empty building, shutters open
      - Scan #3: empty building with shutters closed
- Inspection of processing results
- Scan set #2
  - Detection testing
    - 3 Scans
    - 4 Weapons
      - RPG-7, Dragunov, AK-47, AR-10
    - Positioning of target determined on site with government
    - Confusers added as resources permit



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# Demo April 2010

## Detection Results

- Demo performed under TARDEC supervision
  - TARDEC chose deployment scenarios in real time
- Deployment of weapons and confusers under control of TARDEC
  - Weapons: RPG, Dragunov, AK-47, AR-10
  - Confusers: Person, person with tripod, person with broom
  - 6 building scans: 2 empty building, 4 with weapons/confusers
- Automated detection system
  - Data moved from collection system to detection system via data stick
  - All parts of detection system were automated
- Demo handled as a blind test
  - Truth was not used during testing, only for display purposes



# Demo April 2010

## Detection Results – tp9037

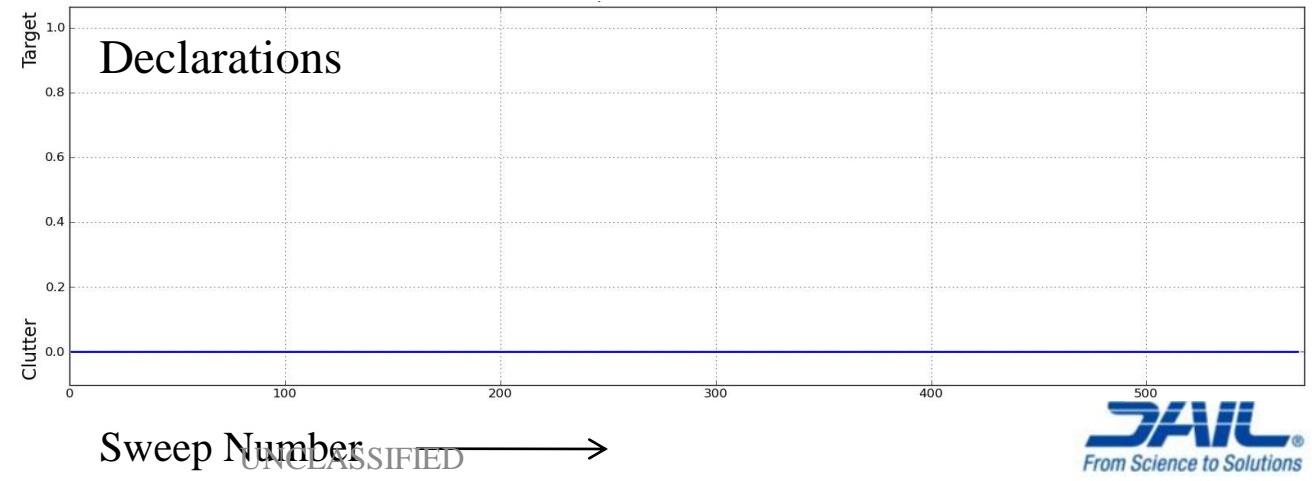
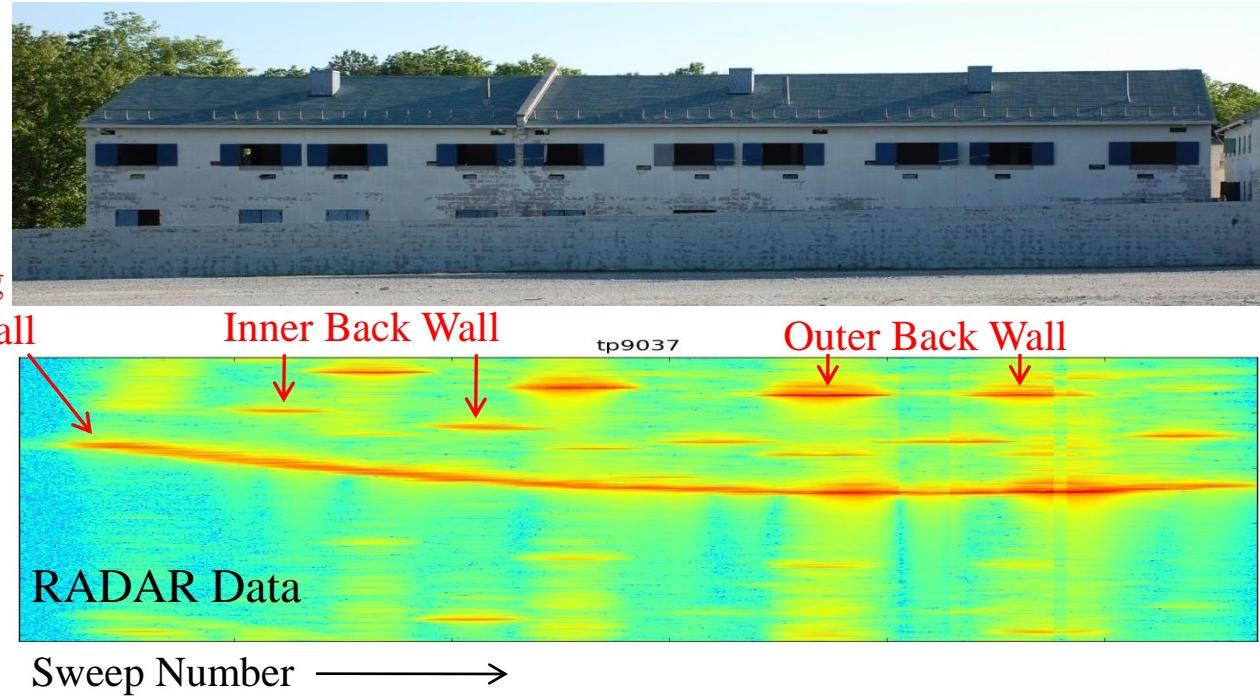
### Scenario

Empty building,  
shutters open

- Munitions  
• None

- Confusers  
• None

- Results  
• No false alarms





# Demo April 2010

## Detection Results – tp9038

### Scenario

Empty building,  
people as  
confusers

#### Munitions

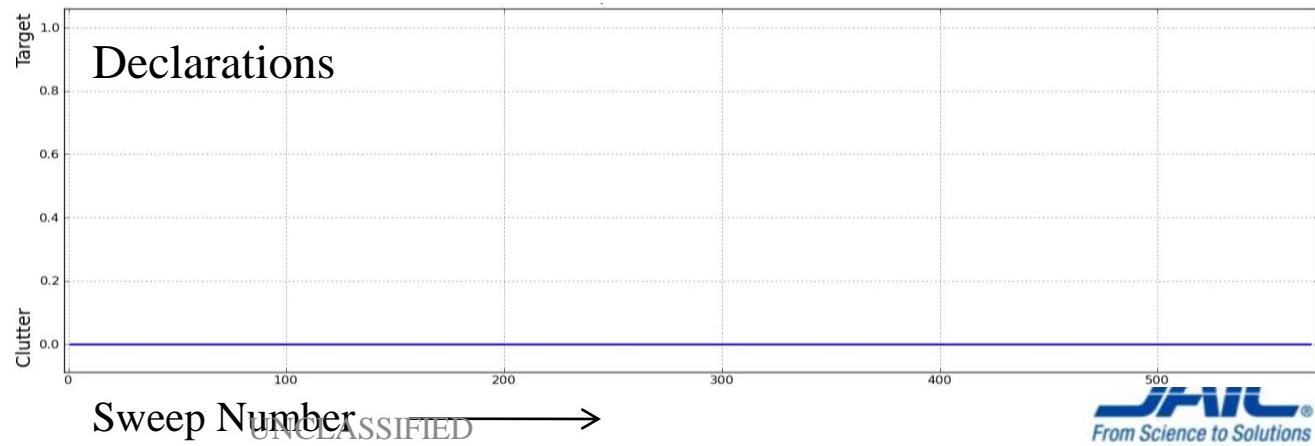
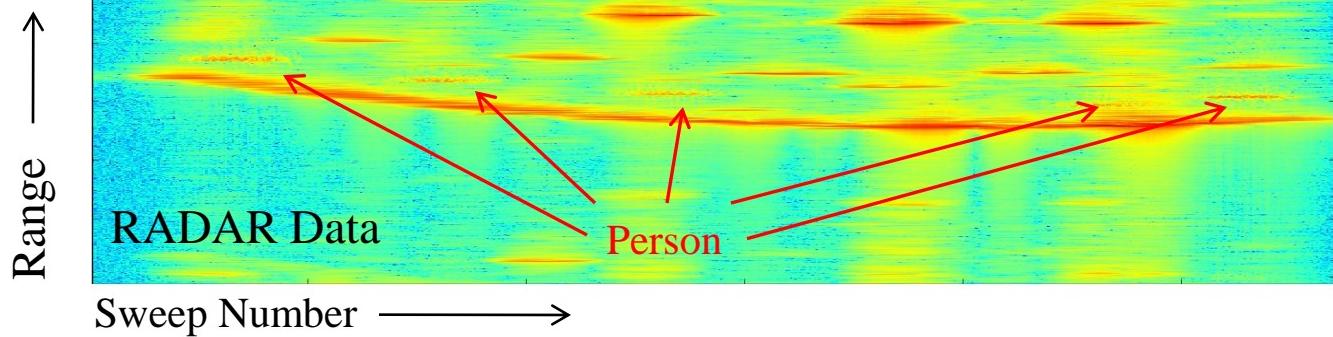
- None

#### Confusers

- Person

#### Results

- No false alarms





# Deployed Persons



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# Demo April 2010

## Detection Results – tp9039

### Scenario

Empty  
building, shutters closed



tp9039

### Munitions

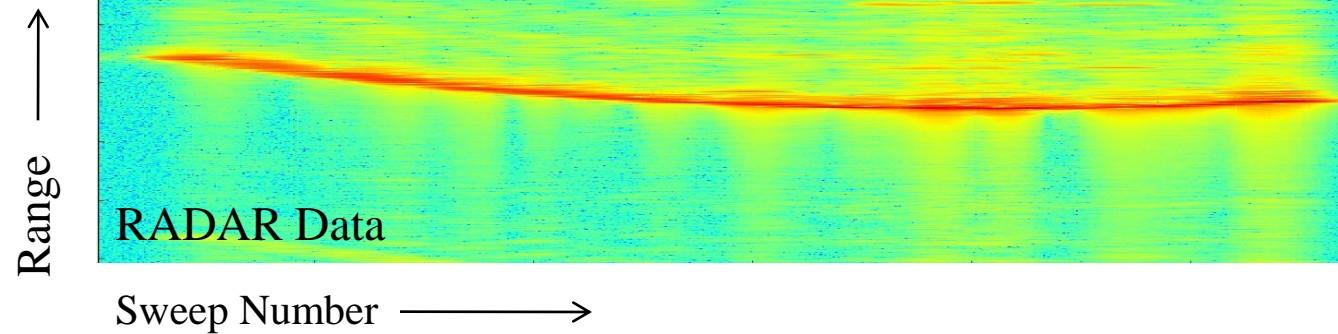
- None

### Confusers

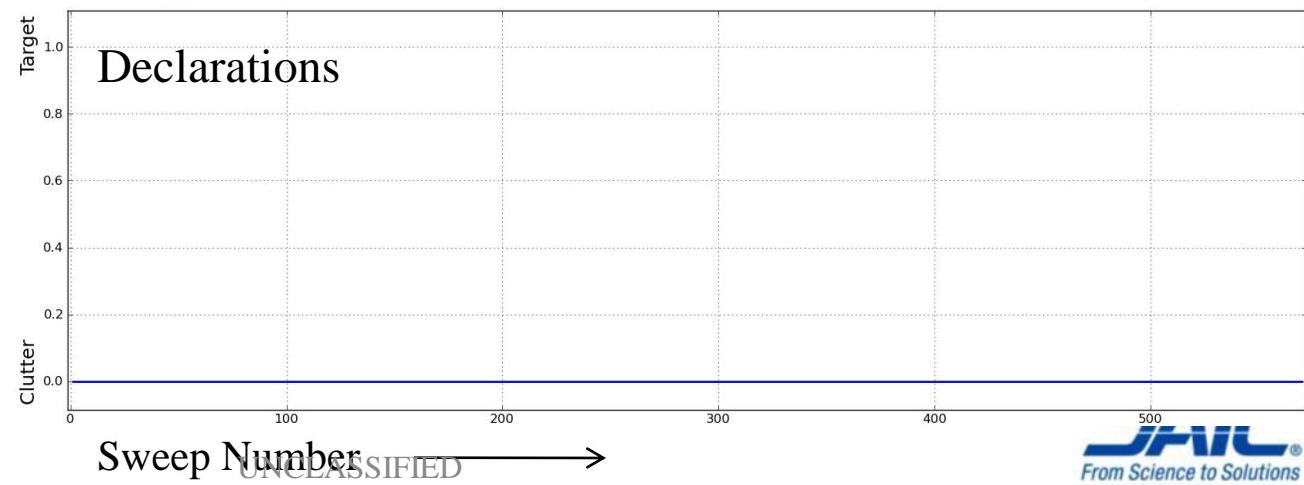
- None

### Results

- No false alarms



Range →  
Sweep Number →



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Sweep Number →



# Demo April 2010

## Detection Results – tp9040

### Scenario

#### Munitions

- Dragunov
- RPG
- AK47
- AR10

#### Confusers

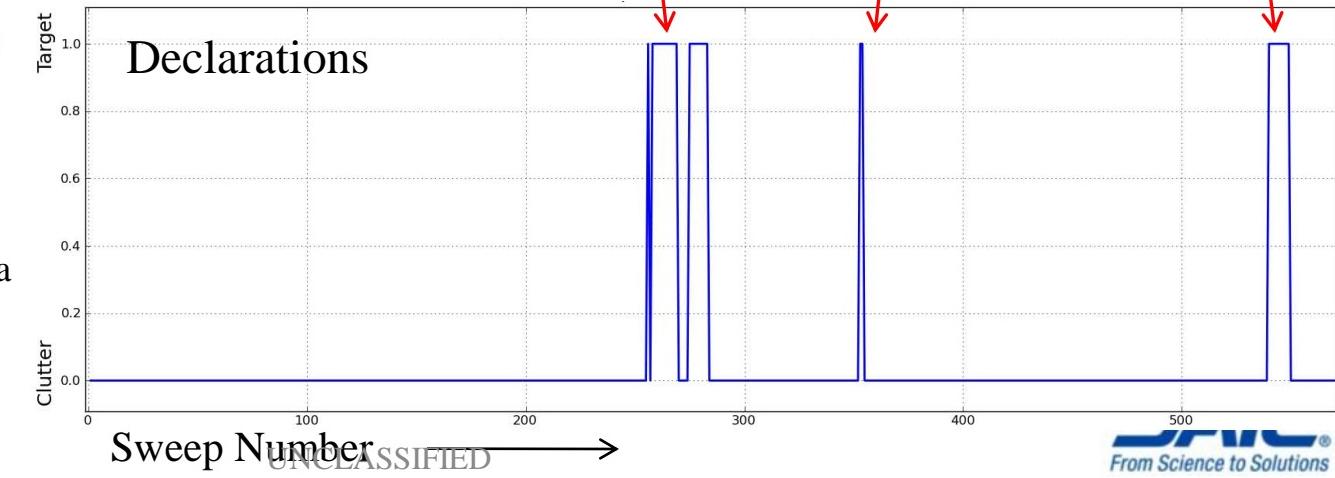
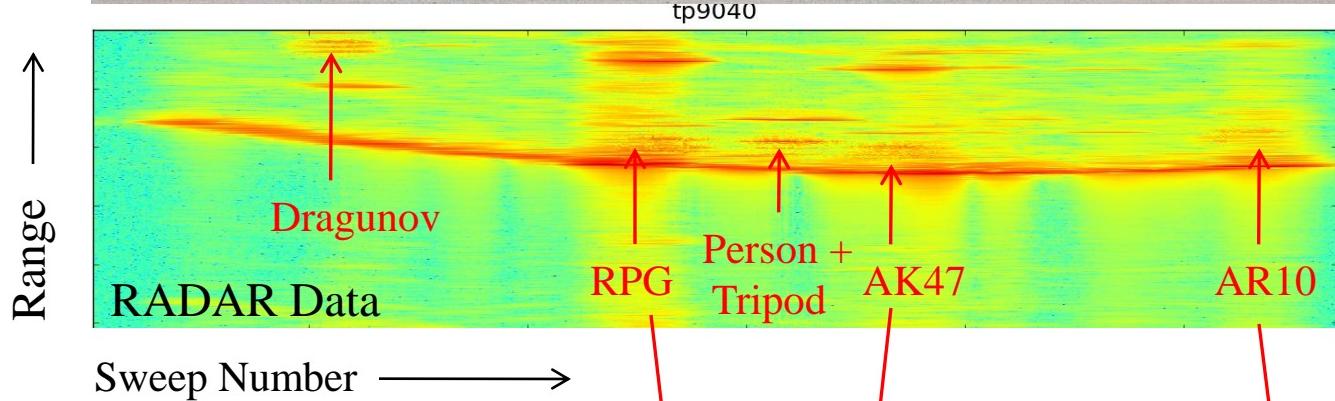
- Person with Tripod

#### Results

- RPG, AK47, AR10 detected as weapons
- Dragunov was missed
- Person+Tripod was not a false alarm

#### Notes

- Dragunov was in back room, outside search area



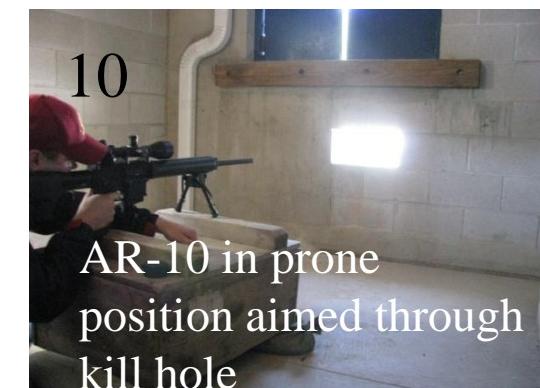
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# Deployed Persons



Confuser targets  
aimed at  
RADAR



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# Demo April 2010

## Detection Results – tp9041

### Scenario

#### Munitions

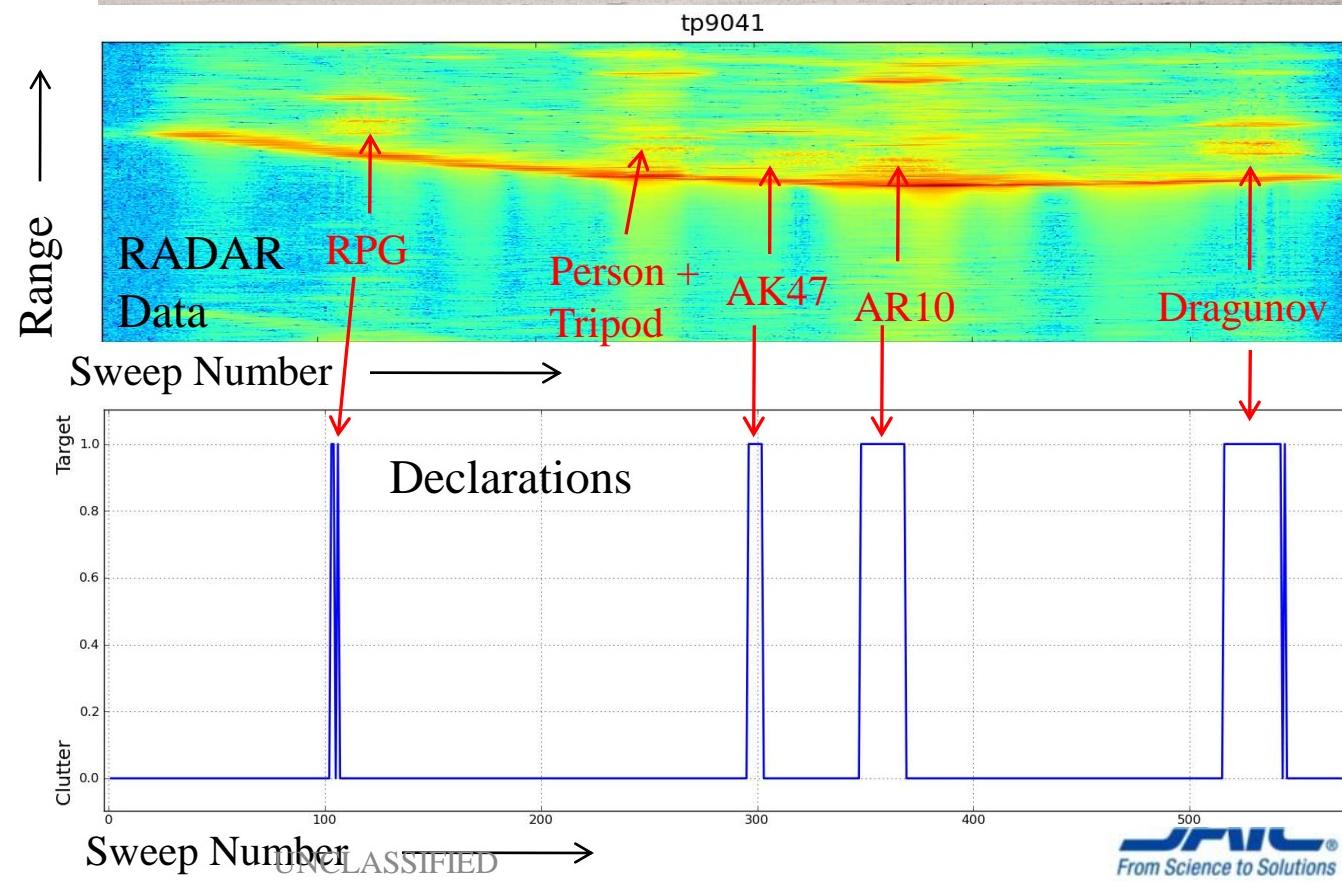
- RPG
- AK47
- AR10
- Dragunov

#### Confusers

- Person with Tripod

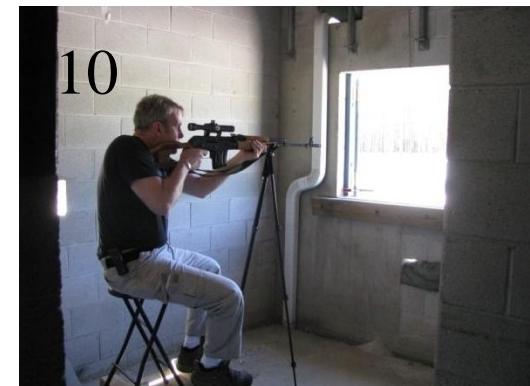
#### Results

- RPG, AK47, AR10, and Dragunov detected as weapons
- Person+Tripod declared as clutter





# Deployed Persons



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# Demo April 2010

## Detection Results – tp9042

### Scenario

#### Munitions

- Dragunov
- AK47
- RPG
- AR10

#### Confusers

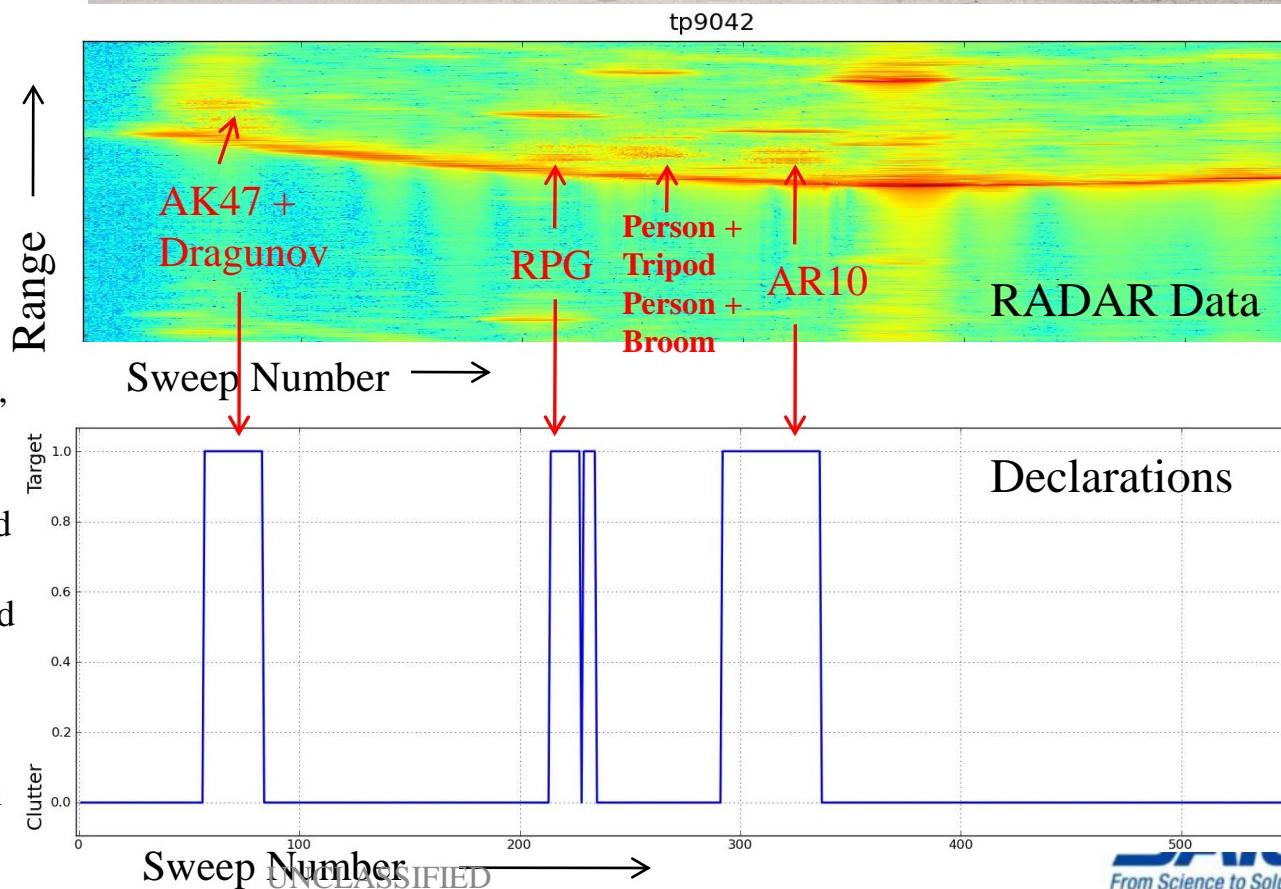
- Person with Tripod
- Person with Broom

#### Results

- Dragunov, AK47, RPG, and AR10 detected as weapons
- Person+Tripod declared as clutter
- Person+Broom declared as clutter

#### Notes

- AK47 and Dragunov in same room





# Deployed Persons



Dragunov in prone position aimed through kill hole



Window 1 had 2 weapons (AK-47 and Dragunov)



# Summary: Algorithm Declarations

	Window 1	Window 2	Window 3	Window 4	Window 5	Window 6	Window 7	Window 8	Window 9	Window 10
Clutter Test, Windows Open										
Clutter Test, Windows Open	Person		Person		Person				Person	Person
Clutter Test, Windows Closed										
Detect Test 1		Dragunov			RPG	Person + Tripod	AK47			AR10
Detect Test 2		RPG			Person + Tripod	AK47	AR10			Dragunov
Detect Test 3	AK47 + Dragunov			RPG	Person+ Tripod Person+ Broom	AR10				

**Detection**

**Missed Detection/  
Outside Search Area**

**False Alarm**

**Confuser**

Correct Declaration

Incorrect Declaration

- ❖ All weapons within search range of system were detected
- ❖ No false alarms
- ❖ Automated algorithm used 4 minutes for declarations (non-real time code)